WHAT IS CLAIMED IS:

1. A semiconductor device comprising:

a semiconductor substrate;

a gate insulating film formed on the semiconductor substrate; and

a gate electrode formed on the gate insulating film, wherein

the gate insulating film is a layered film including a plurality of nitrogen-containing metal compound layers having nitrogen atoms thermally diffused therein.

2. The semiconductor device according to claim 1, wherein

the plurality of nitrogen-containing metal compound layers each contain an element selected from the group consisting of Hf, Zr, La, Al, Si, and Y.

3. A semiconductor device comprising:

a semiconductor substrate;

a gate insulating film formed on the semiconductor substrate; and

a gate electrode formed on the gate insulating film, wherein

the gate insulating film is a layered film including a plurality of nitrogen-containing metal compound layers having different nitrogen compositions (1 - q), expressed by the

following general formula:

$M_pM'_{1-p}O_qN_{1-q}$,

where $1 \geq p \geq 0$, $1 > q \geq 0$, and M and M' each represent an element selected from the group consisting of Hf, Zr, La, Al, Si, and Y.

4. A semiconductor device comprising:

a semiconductor substrate;

a gate insulating film formed on the semiconductor substrate; and

a gate electrode formed on the gate insulating film, wherein

the gate insulating film is a layered film including:

a first metal compound layer containing a metal compound expressed by the chemical formula $M^1O_xN_{1-x}$;

a second metal compound layer formed on the first metal compound layer, containing a metal compound expressed by the chemical formula $M^2O_yN_{1-y}$; and

a third metal compound layer formed on the second metal compound layer, containing a metal compound expressed by the chemical formula $M^3O_zN_{1-z}$, where $1 \geq y > x \geq 0$, $1 \geq y > z \geq 0$, and M^1, M^2, and M^3 each independently represent an element selected from the group consisting of Hf, Zr, La, Al, Si, and Y.

5. The semiconductor device according to claim 4, wherein:

$1 > y > x > 0$ and $1 > y > z > 0$ hold; and

each of the first, second, and third metal compound layers is one selected from the group consisting of a metal oxynitride layer and a metal nitride layer.

6. The semiconductor device according to claim 4, wherein

C_1 and C_3 both reach or exceed 3×10^{20} atom/cm^3, where C_1 is a maximum nitrogen concentration in the first metal compound layer, and C_3 is a maximum nitrogen concentration in the third metal compound layer.

7. A semiconductor device comprising:

a semiconductor substrate;

a gate insulating film formed on the semiconductor substrate; and

a gate electrode formed on the gate insulating film, wherein

the gate insulating film includes a layered film including layers expressed by the following respective formulas:

$M_rM'_{1-r}O_uN_{1-u}$, and

$M_sM'_{1-s}O_vN_{1-v}$,

where $1 > r > 0$, $1 > s > 0$, $1 \geq u \geq 0$, $1 \geq v \geq 0$, and u and v are different values, and M and M' represent different elements each selected from the group consisting of Hf, Zr, La, Al, Si, and Y.

8. The semiconductor device according to claim 1, wherein

the layered film is formed by atomic layer deposition.

9. A method of manufacturing a metal compound thin film comprising:

forming a first metal compound layer on a substrate by atomic layer deposition;

performing annealing on the first metal compound layer in an atmosphere containing a nitrogen compound gas, thereby diffusing nitrogen into the first metal compound layer; and

forming a second metal compound layer on the first metal compound layer by atomic layer deposition.

10. The method of manufacturing a metal compound thin film according to claim 9, wherein

the first metal compound layer and the second metal compound layer each contain an element selected from the group consisting of Hf, Zr, La, Al, Si, and Y.

11. A method of manufacturing a semiconductor device comprising:

forming a gate insulating film and a conductive film on a semiconductor substrate in this order, the gate insulating film being made of a metal compound thin film; and

selectively removing the gate insulating film and the

conductive film to form a gate electrode, wherein

the gate insulating film made of the metal compound thin film is formed by the method of manufacturing a metal compound thin film according to claim 9.